Fresh Air Handling Unit With Horse Shoe Heat Pipe + Kitchen Ecology Units (Type-1)

System-1:
FAHU-T02-04 - Serves VAVs in All Day Dining & Lounge Kitchen Hoods Level T03
KEF-T02-03 - Serves All Day Dining Kitchen Hood Level T03
KEF-T02-07 - Serves Lounge Kitchen Hood Level T03

System-2:
AHU-T02-01 - Serves Hot Kitchen Hood Level GF
KEF-T02-02 - Serves Hot Kitchen Hood Level GF

System-3:
AHU-T02-02 - Serves VAVs in Bakery, Pork, Pool Pantry & Lounge Pantry Kitchen Hoods Level GF & T01
KEF-T02-01 - Serves Bakery Hood Level GF
KEF-T02-04 - Serves Pork Kitchen Hood Level GF
KEF-T02-05 - Serves Pool Pantry Hood Level T01
KEF-T02-06 - Serves Lounge Pantry Hood Level T01

System-4:
MA-AHU-T69-01 - Serves Restaurant Kitchen Hood Level T70
ECO-T72-01 - Serves Restaurant Kitchen Hood Level T70

A) System Description

The system consists of Fresh Air Handling Unit and kitchen extract fan.

FAHU consists of supply fan with VFD, chilled water cooling coil with modulating valve, fresh air open/close damper, pre-filter and bag filter sections, horse shoe heat pipe.

In System-1 and System-3, supply air is being served to the kitchen hoods through VAVs.

Kitchen Ecology Units consist of extract fan with VFD & extract air open/close damper.

B) Kitchen Operational Mode

- System is time scheduled through BMS to define operational mode. The following time schedules shall be defined:

a) All Day Dining Scheduler.
b) Lounge Kitchen Scheduler.
c) Hot Kitchen Scheduler.
d) Pool Pantry Scheduler.
e) Lounge Pantry Scheduler.

f) Bakery Scheduler.
g) Pork Kitchen Scheduler.
h) Restaurant kitchen Scheduler.

- Operational Mode

System shall continue to operate as per sequence established in following pages.

- Non-operational Mode

System shall be turned off or continue to operate at reduced speeds to maintain minimum ventilation in the space.

The following table lists the VAVs in the kitchen with areas served, source of treated air to VAV, corresponding source of extract air from space and VAV operation mode. Note that extract air **does not** have VAVs.

S. No.	VAV Reference	Area served by VAV	Source of treated air to VAV	Corresponding source of extract from space	Interlock between supply and extract	VAV Operation mode
1	VAV-24	All Day Dining Kitchen Hood	FAHU-T02-04	KEF-T02-03	Yes	*CAV
2	VAV-10	Lounge Kitchen Hood	FAHU-T02-04	KEF-T02-07	Yes	*CAV
3	VAV-14	Bakery Hood	AHU-T02-02	KEF-T02-01	Yes	*CAV
4	VAV-12	Bakery Hood	AHU-T02-02	KEF-T02-01	Yes	*CAV
5	VAV-9	Bakery	AHU-T02-02	-	-	*T
6	VAV-9	Pork Kitchen Hood	AHU-T02-02	KEF-T02-04	Yes	*CAV
7	VAV-14	Pool Pantry Hood	AHU-T02-02	KEF-T02-05	Yes	*CAV
8	VAV-7	Pool Pantry	AHU-T02-02	-	-	*T
9	VAV-10	Lounge Pantry Hood	AHU-T02-02	KEF-T02-06	Yes	*CAV
10	VAV-5	Lounge Pantry	AHU-T02-02	-	-	*T

***CAV – Constant Air Volume**
***T – Space/Return Plenum Temperature Control**

C) FAHU & KEF Control and Monitoring

Operator shall be provided with a time schedule to select hood working and non-working times. FAHU & Kitchen extract fans shall be commanded to run based on the time channels of time scheduler and if the H/O/A switch is in the 'Auto' position.

Initially when time scheduler activates, BMS shall send open command to KEF damper. Once KEF damper open status is received from actuator auxiliary switch, Kitchen Extract Fan is commanded to start.

Once BMS receives KEF run status from air flow switch **(QBM81-3)** BMS shall command FAHU damper to open. Once FAHU damper open status is received from actuator auxiliary switch, FAHU

supply fan is commanded to start. Once fan run status is confirmed to BMS via differential pressure switch **(QBM81-3)**, cooling coil temperature control loop shall be activated.

VFD of kitchen extract fan shall be commanded to run at a fixed speed as per inputs from air balancing contractor. FAHU VFD shall be commanded to run at a fixed offset with respect to KEF so as to maintain a negative pressure at the hood, except for AHU-T02-02. A duct static pressure sensor **(QBM3020-10)** shall be installed at 2/3rd of the supply duct of AHU-T02-02 and the supply fan VFD shall be modulated to maintain the duct static pressure at the set point as per inputs from air balancing contractor.

KEF and FAHU shall be interlocked with each other such that if one fails the other shall also switch off as per the following table.

System - 1					
Sl. No.	**All Day Dining Hood**	**Lounge Kitchen Hood**	**FAHU-T02-04 (%)**	**KEF-T02-03 (%)**	**KEF-T02-07 (%)**
1	0	0	0	0	0
2	0	1	30	0	100
3	1	0	71	100	0
4	1	1	100	100	100

System - 2				
Sl. No.	**Hot Kitchen Hood-1**	**Hot Kitchen Hood-2**	**AHU-T02-01 (%)**	**KEF-T03-03 (%)**
1	0	0	0	0
2	0	1	50	50
3	1	0	50	50
4	1	1	100	100

Sl. No.	**Bakery Hood**	**Pork Kitchen Hood**	**Pool Pantry Hood**	**Lounge Pantry Hood**	**AHU-T02-02 (%)**	**KEF - T02-01 (%)**	**KEF-T02-04 (%)**	**KEF-T02-05 (%)**	**KEF-T02-06 (%)**
1	0	0	0	0	0	0	0	0	0
2	0	0	0	1	13	0	0	0	100
3	0	0	1	0	26	0	0	100	0
4	0	0	1	1	39	0	0	100	100
5	0	1	0	0	12	0	100	0	0
6	0	1	0	1	25	0	100	0	100
7	0	1	1	0	38	0	100	100	0
8	0	1	1	1	51	0	100	100	100
9	1	0	0	0	50	100	0	0	0

10	1	0	0	1	63	100	0	0	100
11	1	0	1	0	76	100	0	100	0
12	1	0	1	1	89	100	0	100	100
13	1	1	0	0	68	100	100	0	0
14	1	1	0	1	75	100	100	0	100
15	1	1	1	0	88	100	100	100	0
16	1	1	1	1	100	100	100	100	100

System - 4			
Sl. No.	**Restaurant Kitchen Hood**	**MA-AHU-T69-01 (%)**	**ECO-T72-01 (%)**
1	0	0	0
2	1	100	100

Note:- Minimum VFD speed to be confirmed by VFD supplier.

In the event of BMS giving a start/stop command to KEF and run status of the same is not established vide differential pressure switch after an interrogation time of 30 seconds (adjustable), BMS shall raise a KEF fail to Run Alarm. BMS shall disable all commands to the KEF. The KEF shall not run until alarm for the same has been acknowledged and reset from the BMS workstation. The same shall be followed under trip conditions.

In the event of BMS giving a start/stop command to FAHU and run status of the same is not established vide differential pressure switch after an interrogation time of 1 minute (adjustable), BMS shall raise a FAHU failed to Run Alarm. BMS shall disable all commands to the FAHU. The FAHU shall not run until alarm for the same has been acknowledged and reset from the BMS workstation. The same shall be followed under trip conditions

Differential pressure switches **(QBM81-5)** shall be installed across the pre-filter & bag filter to monitor the dirty status of the filter. If the pressure across the filters exceeds the pre-determined set point (as recommended by the supplier)(adjustable), BMS shall raise a dirty filter alarm.

D) Temperature Control and monitoring (FAHU)

These shall be combined temperature & relative humidity sensor shall be installed on supply duct **(QFM2160).** Cooling coil valve shall be modulated as per PI (Proportional Integral) logic to maintain supply air temperature at set point (18°C, adjustable from BMS workstation).

BMS shall also monitor chilled water inlet & outlet temperatures **(QAE2112.010)** & cooling coil off coil air temperature **(QAM2112.200).**

Fresh air temperature & relative humidity **(QFM2160)** shall be monitored at levels T02, T14, T51 and T69 as global set point.

E) VAV Control (System – 1 and 3)

- VAVs shall be controlled by its self-contained controller independent of BMS.
- VAVs that serve area with corresponding extract source shall be controlled to provide constant air volume. BMS shall provide Kitchen Extract fan 'ON' status to VAV control system via software integration over BACnet/MSTP. When the extract fan is ON, VAV control system shall command the VAV to allow constant volume of air **Vmax** across the VAV box. When the extract fan is OFF, VAV control system shall command the VAV to shut close or at least allow a lower constant air volume **Vmin** across the VAV box as per below matrix.
- The VAV control system shall command all other VAVs (3 Nos.) to maintain space/return air temperature

System – 1

Sl. No.	VAV Reference	All Day Dining Kitchen (T03) Scheduler		Lounge Kitchen (T03) Scheduler	
	Scheduler Status →	ON	OFF	ON	OFF
		FLOW ↓	FLOW ↓	FLOW ↓	FLOW ↓
1	VAV-24	Vmax	0		
2	VAV-10			Vmax	0

System – 3

Sl. No.	VAV Reference	Pool Pantry (T01) Scheduler		Lounge Pantry (T01) Scheduler		Bakery (GF) Scheduler		Pork Kitchen (GF) Scheduler	
	Scheduler Status	ON	OFF	ON	OFF	ON	OFF	ON	OFF
		FLOW ↓	FLOW ↓	FLOW ↓	FLOW ↓	FLOW ↓	FLOW ↓	FLOW ↓	FLOW ↓
1	VAV-14	-	-	-	-	Vmax	0	-	-
2	VAV-14	-	-	-	-	Vmax	0	-	-
3	VAV-9	-	-	-	-	*	*	-	-
4	VAV-9	-	-	-	-	-	-	Vmax	0
5	VAV-14	Vmax	0	-	-	-	-	-	-
6	VAV-07	*	*	-	-	-	-	-	-
7	VAV-10	-	-	Vmax	0	-	-	-	-
8	VAV-05	-	-	*	*	-	-	-	-

'Vmax' – VAV commanded to allow maximum design air flow across box.
'Vmin' – VAV commanded to allow minimum design air flow across box.
'0' – VAV commanded to shut close.

'*' – VAV controlled to maintain space/return temperature.
'-' – Not applicable.

F) Fire Alarm

In the event of fire, BMS shall simulate the following action:

(i) De-activate all controls (Switch OFF both FAHU and kitchen extract fans and close cooling coil valve)

BMS shall only simulate the above, however MCC (Motor Control centre) will take necessary corrective action through hard wired contacts from the fire alarm panel.

G) Alarms

The followings alarms shall be raised on BMS

S.NO.	ALARM	PRIORITY
1	FAHU supply fan failed to run alarm	High
2	FAHU supply fan trip alarm	High
3	FAHU damper failed to open alarm	High
4	FAHU pre-filter dirty alarm	Low
5	FAHU bag filter dirty alarm	Low
6	KEF fan failed to run alarm	High
7	KEF trip alarm	High
8	KEF damper failed to open alarm	High
9	FAHU maintenance alarm	Low

Note:- Maintenance alarms shall be raised based on run hours.

F) TRENDS

The following points shall be trended at every 10 minutes of interval:

i) FAHU supply air temperature
ii) FAHU supply air temperature set point
iii) FAHU static pressure set point (only for AHU-T02-02)
iv) FAHU supply air relative humidity
v) FAHU cooling coil valve command
vi) FAHU cooling coil valve feedback
vii) FAHU chilled water inlet temperature
viii) FAHU chilled water outlet temperature
ix) FAHU supply fan VFD feedback
x) KEF VFD feedback